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Application Number	09/996,244
Filing Date	November 28, 2001
First Named Inventor	Schaefer et al.
Art Unit	3641
Examiner Name	Behrend, Harvey E.
Attorney Docket Number	594826-001C1

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
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- ☑ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
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SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

MAR 18 2005 PATENT & TRADEMARK OFFICE

Application of

Applicant	:	Schaefer et al.
Serial No.	:	09/996,244
Filed	:	November 28, 2001
Title	:	TRAPPING AND STORAGE OF FREE THERMAL NEUTRONS IN FULLERENE MOLECULES
Docket	:	594826-001C1
Art Unit	:	3641
Examiner	:	Behrend, Harvey E.

MAIL STOP APPEAL BRIEF-PATENTS
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Sir:

SECOND SUBSTITUTE APPEAL BRIEF

This is an appeal from the Final Rejection mailed December 12, 2003. A Notice of Appeal was submitted on March 12, 2004 with a one month extension of time. This Second Substitute Brief is filed in response to the Notice Under 37 CFR §1.192(c) dated September 8, 2004 and the Office Action dated February 16, 2005.

(1) Real Party in Interest

This application has not been assigned. The applicants are the real party in interest.

(2) Related Appeals and Interferences

This application is a continuation of U.S. Application Serial No. 08/376,846 filed January 23, 1995 which was the subject of an appeal (Appeal No. 1999-1059) decided September 28, 2001. A copy of the Decision of the Board is attached in the Appeals Appendix. There are no other appeals or interferences pending which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

(3) Status of Claims

Claims 1-8, 10-14, 16-19, 29, 30-34 are pending in the application.

Claims 30-32 are withdrawn from consideration.

Claims 9, 15, 21-28 are canceled.

The appealed claims are claims 1-8, 10-14, 16-19, 29. 33-34.

(4) Status of Amendments

The Amendment under 37 CFR §1.116 filed May 4, 2004 has been entered.

(5) Summary of the Invention

(A) Claim 1

Fullerenes are extremely stable molecules of carbon that take the form of a hollow geodesic sphere containing 32 to several hundred carbon atoms (page 1, lines 4-6). Fullerenes containing 60 carbons(C_{60}) are better known as Buckminster fullerenes or "buckyballs." C_{60} fullerene has an icosahedral symmetry consisting of 12 five-member rings and 20 six-member rings and resembles the patchwork faces of a soccer ball. The invention as defined in independent claim 1 is a fullerene molecule having one or more thermal neutrons trapped within its cage-like structure. The invention is based upon the discovery that free thermal neutrons can be trapped within the cage-like structure of a fullerene molecule (page 3, lines 9-13).

(B) Claim 19

Claim 19 is directed to a more specific embodiment of the invention in which the fullerene molecule is a C_{70} fullerene molecule. C_{70} fullerenes contain 25 six-membered rings and have a shape resembling a rugby ball (page 1, lines 4-13). Claim 19 further defines the fullerene molecule containing the trapped thermal neutron by reciting that the neutrons are capable of being released from the fullerene molecule at a location removed from the source of the neutrons by disassembling the fullerene molecule using a laser, an electric field, a magnetic field, non-coherent electromagnetic radiation, particle bombardment, pressurization, mechanical force, heat, chemical reaction, electric current, or any combination thereof or by impinging a beam of neutron-containing fullerene molecules on a metal foil. These properties of the trapped thermal neutron are disclosed in the application at page 3, line 26 to page 4, line 8.

To make fullerenes in accordance with the invention, *free thermal neutrons* are used to irradiate a sample of a fullerene which traps the thermal neutrons within the cage-like structure of the fullerene. After exposure, the neutrons remain confined with the fullerene molecule until they are released or decay (page 3, lines 1-15). Conceptually, the manufacture of the fullerene is simple. A vial of fullerene is placed in the thermal neutron flux of a nuclear reactor. The

Example at page 7 of the application teaches putting the fullerene in the carrier tubes in a nuclear reactor and irradiating at a steady state power of 10 to 50 kw for 5 to 15 minutes and recovering the sample (page 7, lines 22-26).

By a process known as "half-life stripping" interfering gamma emissions are stripped from gamma spectrographic data. When this process is completed, the applicants find that the fullerene exhibits a beta emission with a half-life of 10 minutes (page 3, line 24). As explained, at page 9, line 23-30; there are very few pure beta particle emitters with a half-life anywhere near ten minutes. The rarity of these emitters, their chemical nature and the chemical nature of the fullerene all point to the conclusion that they cannot be the source of the pure beta emitter, the applications have observed. The only source of this beta emission known to the applications is the free thermal neutron (page 9, lines 28-30).

(6) Grounds of Rejection to Be Reviewed on Appeal

The Grounds of Rejection are:

(A) Claims 1-8, 10-14, 16-19, 29, 33, and 34 stand rejected under 35 USC §112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

(B) Claims 4-8, 10-14, 16-19 stand rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

For the purpose of this appeal, as they relate to the first Ground of Rejection (A) above, the claims are considered to stand or fall together. As they relate to the second Ground of Rejection (B), because this rejection, by its nature, depends on the specific language in each claim, each claim must stand or fall on its own merit as applicants' arguments will indicate.

(7) Argument

(A) §112, First Paragraph Rejection.

With respect to the rejection under 35 U.S.C. §112, first paragraph, the Office contends that the specification does not describe the invention in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use it. In making the rejection, the Office states that there is "no reputable evidence now of record" to support the applicant's argument that the neutron's magnetic field will keep it in the center or

cavity of a fullerene; there is "no reputable evidence of record" to support the applicant's postulate that the electron cloud of a fullerene molecule provides a magnetic field that will trap the neutron; and there is "no disclosure of what causes" a neutron from a beam of a radiating thermal neutron to penetrate only one wall of the fullerene. The applicants submit that this rejection in reality has nothing to do with enablement. The rejection is based upon unsupported, "suspicions" that the applicants have not done what they claim to have done; namely, trapped a thermal neutron in a fullerene molecule. Such suspicions do not provide an acceptable basis for a rejection under §112 of the patent statute. As explained below in more detail, the applicants have placed fullerene molecules in a neutron flux, they have recovered the product, examined the nuclear emissions, and determined through an analytical process known as gamma stripping, that the fullerene includes a beta emission that is characteristic of a trapped thermal neutron. This is all that is required for enablement. The Office contends there are issues of experimental error, misinterpretation of experimental results, without putting forth any technical basis whatsoever for these assertions. The applicants submit the Office has not met its burden and, as such, by statute, the applicants are entitled to patent protection.

The applicants submit that the rejection of claims 1-8, 10-14, 16-19, 29, 33 and 34 under the first paragraph of 35 U.S.C. §112 is directly contrary to *In re Cortright*, 165 F. 3d 1353 (Fed. Cir. 1999) where the Federal Circuit cited its precedent in *Newman v. Quigg*, 877 F. 2d 1575, 1581 (Fed. Cir. 1989) and *Fromson v. Advanced Offset Plate, Inc.*, 720 F. 2d 1565, 1579 (Fed. Cir. 1983) and held that an inventor does not need to prove the scientific principles upon which his invention works. In making the rejection under §112, first paragraph, the Office raises issues of experimental error and misinterpretation of experimental results (Office Action, December 2, 2003, page 4). However, under *Cortright* and its predecessor cases, questions of experimental error and disputes regarding the interpretation of results are not issues under §112, first paragraph. Rather these issues go to the underlying theory for the invention and not enablement.

The applicants submit that the issues under §112 first paragraph are simple; namely, have the applicants taught how to make their invention. The applicants have described a process in which a vial filled with fullerene compound is placed in the thermal neutron flux of a nuclear reactor, irradiated, removed, its β-decay monitored and analyzed, and the presence of thermal neutrons in the sample confirmed. The applicants submit that these teachings meet the enablement requirement of §112 and Dr. Joseph Talnagi, an expert in the field from The Ohio State University, agrees his Second Declaration that is of record and attached hereto in the

Evidence Appendix. A person skilled in the art, based upon the teachings in the Specification can clearly take fullerene molecules, which are commercially available, and place them in the thermal neutron flux of a nuclear reactor and obtain a product which exhibits a beta emisssion. One issue that the Office raises is whether this beta emission is in fact due to a trapped thermal neutron. The applicants have explained in their application their method for analyzing the beta emission and, by the process of eliminating all other possible sources of the emission, determining that the emission is that of a free thermal neutron. This too is confirmed in the Second Declaration of Dr. Talnagi.

The Office is maintaining the §112, first paragraph rejection based on unsupported suspicions that the β-emitter the applicants are observing may not be a trapped thermal neutron and, if it is, that neutron may not be inside the cage of the fullerene. These unsupported suspicions particularly in the face of Dr. Talnagi's affidavit, do not provide an appropriate basis for rejection under §112, first paragraph. *In re Marzocchi*, 169 U.S.P.Q. 367 (CCPA 1971).

The Office bases the enablement rejection on a number of assertions that go solely to the underlying theory for the invention and that are completely inconsistent with *Cortright.* The Office asserts that there is no reputable evidence that the neutron's magnetic field will keep it in the center of the fullerene, but the claims say nothing about magnetic fields. The Office asserts that there is no evidence that the fullerene electron cloud keeps the neutron in the center of the fullerene, but the claims say nothing about an electron cloud. The Office contends that the disclosure teaches nothing about having enough energy to penetrate one side of the fullerene but not the other, but the claims say nothing about this. These are mere theories which, under *Cortright* are "icing on the cake" but not required under §112, first paragraph.

The applicants have previously explained that a fullerene molecule traps a neutron inside the fullerene's internal cavity when the neutron has enough energy to penetrate the wall of the fullerene molecule only once. The applicants contend that a neutron loses energy in penetrating the wall of the fullerene molecule and reaches the interior cavity of the fullerene with less energy than it had before it first penetrated the wall of the fullerene molecule. This process traps the neutron when at this new, lower energy state, the neutron lacks the energy to penetrate the wall of the fullerene molecule again and escape. Inside the fullerene molecule, the neutron has no means of gaining the necessary energy to escape so it remains inside the fullerene molecule until it decays.

The applicants have previously explained that individual neutrons in the neutron flux of a nuclear reactor have a broad range of energies dependent on the location of the measurement of the energies of the neutrons. Some very low energy neutrons that reach the fullerene sample within the reactor may be unable to penetrate a fullerene molecule at all. On the other hand, high-energy neutrons would pass right through both walls of the fullerene molecule in the sample as the examiner suggests. The applicants contend that there is a mid-range of neutron energies where a neutron encountering a fullerene molecule has enough energy to penetrate the wall of the fullerene molecule to reach the interior cavity and that in the process the neutron loses enough energy such that it cannot again penetrate the wall of the fullerene molecule to escape. Free neutrons exchange kinetic energy with moderators in nuclear reactors exactly for extracting energy from high-energy neutrons. This is how nuclear reactors produce thermal or low energy neutrons. This process occurs without the nuclei of the moderator capturing the neutron during the energy transfer. This demonstrates that neutrons do loose energy through such interactions. The wall of the fullerene molecule appears to act as a moderator extracting energy from the neutron as it passes into the fullerene's internal cavity. The applicants believe that the gross features of the capture process are no more complicated than this.

The fact that after irradiation by neutrons, fullerene molecules exhibit decay radiation that is indistinguishable from the decay of free neutrons is strong evidence of the existence of the neutrons as free thermal neutrons inside the fullerene.

In persisting in the rejection, the Office contends that the applicants have not proved that the neutron is inside the fullerene cage as opposed to at some other location. The applicants submit that this is the weakest aspect of the Office's rejection simply because, if we assume for the sake of argument that the β-emitter is in fact a thermal neutron, there is simply no other place that this neutron could be except in the fullerene cage and still emit a β-particle. Dr. Talnagi attests to this in his affidavit. But for the fullerene cage, the thermal neutron would interact with other nuclei and/or be consumed such that it could not exhibit the characteristic β-emission. Accordingly, in order to behave like a free thermal neutron and exhibit its characteristic β-decay, the neutron must be held in a location in which it is effectively isolated from interaction with other nuclei. The only location that could conceivably provide this type of isolation is the fullerene cage as attested to by Dr. Talnagi. In view of the Talnagi affidavit, the Examiner's unsupported doubts cannot legally support the rejection.

No other known material exhibits the β-emission observed by applicants. Diamond and graphite do not, even though both graphite and diamond are allotropes of pure carbon as are fullerenes. Diamond and graphite lack the interior cavity unique to fullerenes. Neutron activation is one of the lines of research. There is no reference in the literature to any diamond ever exhibiting beta decay radiation with a half-life of 10.25 minutes. The applicants' own experiments on diamond samples in place of fullerene samples confirm this. Some reactors use graphite as a moderator. There is extensive, published characterization of the behavior of graphite as a neutron moderator in nuclear reactors. There is no published data in the literature identifying graphite's ability to contain free neutrons by either trapping the free neutron or reflecting the neutron within the carbon atoms for a period of minutes after the sample exits the neutron source, as postulated by the examiner. The applicants submit that, no reasonable basis remains for the rejection and the rejection must be withdrawn.

Turning lastly to the need for high purity fullerenes, the applicants wish to clarify for the Board that contaminants do not prevent the fullerene molecules in the contaminated sample from trapping free neutrons. Contaminants may interfere with observing of the beta radiation that is characteristic of the trapped neutrons. Samples with unacceptable contaminants produce beta decay radiation with half-lives between 2.25 and 55 minutes and complicate the post irradiation measurement and observation of the decay of the trapped free neutrons. The applicants have been able to verify trapped thermal neutrons in the fullerene using commercially available fullerene samples as disclosed at page 4, lines 24-27.

The applicants acknowledge that the presence of some contaminants, as has been explained, can result in erroneous post-irradiation measurement results. However, the procedures described in the application are designed to detect such potential sources of error. Further, the applicants identified and developed the half-life stripping procedures described in the application, for just this reason. The applicants anticipated and addressed potential erroneous results. The procedures described in the application agree with standard laboratory procedures related to neutron activation and post irradiation data collection and analysis for removing the influence of contaminants during data analysis. Further, these procedures are consistent with procedures that would be expected to be used by a person with ordinary skill in the art of neutron activation to ascertain and address potential sources on sample contamination and eliminate erroneous data. Clearly, if one skilled in the art is trying to detect a β-emission indicative of a

thermal neutron, one would naturally use a fullerene that does not contain contaminants that interfere with that analysis.

The applicants submit that the Examiner's concerns with experimental error are unsubstantiated and are not a proper basis for rejecting the claims. With respect to possible sources of experimental error related to the determination of the presence of the trapped free thermal neutrons, the applicants have addressed potential sources of error successfully and adequately in the application (page 8, line 3 to page 9, line 17). There have been repetitive sample experiments yielding positive results to demonstrate repeatability. The laboratory maintains equipment in standard maintenance and calibration to insure correct and accurate measurements. The applicants use standard laboratory sample handling procedures to control sample quality. The testing of the irradiated fullerene samples, as described in the application, uses a standard gamma spectrometer, to screen out samples with contaminants that produce beta radiation with half-lives between 2.25 and 55 minutes. This insures that these contaminants will not preclude the successful measurement of the decay of the trapped free neutrons. Finally, the applicants use of standard beta decay data recording and analysis procedures, as commonly used within the industry and described in reference works to analyze the experimental data.

With respect to the use of the gamma spectroscopic assessment of the irradiated samples to eliminate any samples containing identified beta decay emitters with half-lives between 2.25 and 55 minutes, this is a standard laboratory procedure to identify the constituents of the irradiated samples and, using published data, identify any beta decay half-lives within the 2.25 to 55 minute window. The use of gamma spectroscopy of the irradiated fullerene samples to quantify the constituents of the irradiated sample, eliminates from further use those samples containing radionuclides with beta decay half-lives between 2.25 and 55 minutes. Together, this provides adequate assurance that the disclosed methods can adequately demonstrate the presence of trapped free neutrons and that expected sources of error can be precluded from such methods by persons normally skilled in the art of neutron irradiation and related measurement methods.

In summary, the applicants request the Board to reverse the §112, first paragraph rejection. The Example in the application clearly teaches how to make the claimed fullerenes by placing them in a thermal neutron flux. Additionally, the application teaches how to verify the claimed compounds by using spectrographic stripping techniques. The purity of the fullerene simplifies detection but does not preclude one from making the claimed materials.

(B) §112, Second Paragraph Rejection.

The applicants traverse the rejection of claims 4-8, 10-14 and 16-19 under the second paragraph of §112. Because the application of this rejection depends upon the language that is used in each particular claim, the claims cannot stand or fall together. Each claim, and more particularly, the language in each claim must be examined on its own merits.

Originally, the rejection of these claims might have been appropriate, however, during prosecution the claims were rejected to define the application of the fullerene in terms of a property that would be imparted to the fullerene as a result of its use as originally claimed. Having so amended the claims, the applicants submit that their rejection under 35 U.S.C. §112 is improper. Indeed, in the paper dated September 26, 2002, the Examiner stated that the claims would be treated as being directed to the fullerene as opposed to a use or utility.

The applicants submit that the language of the claims is clear that the claims are directed to fullerene molecules that are characterized in that they contain at least one free thermal neutron trapped within their cage-like structure. The Office contends that the claims are indefinite because the claims are directed to uses for the fullerene. The applicants submit the Office's position makes no sense. While the rejected claims were at one time been directed to a proposed use of the fullerenes, the claims were amended to recouch that "use" in terms of a functional capability of the fullerene. As rewritten, the applicants submit a person skilled in the art reading the claims would know that they are directed to a fullerene in which the fullerene and/or trapped neutron are further defined in terms of a property or a suitability or capability.

Claim 4 is directed to the embodiment in which the trapped neutron is defined as being in an accelerated state characterized by higher energy levels. As explained at page 5, line 32, the encapsulated neutrons may be accelerated to energy levels that do not occur naturally by placing an electric charge on the fullerene molecule and then accelerating the charged molecule. Claim 4 defines an embodiment of the invention in which the fullerene contains a trapped free thermal neutron and that trapped free thermal neutron is characterized in that it is a neutron that has been accelerated to an elevated energy level.

Claim 5 is directed to the embodiment in which the fullerene possesses an electrical charge. Again, the claim is not directed to a mere use, but rather to a fullerene in which the fullerene contains an electrical charge. Accordingly, claim 5 is directed to the fullerene of claim 1 modified by claim 4 wherein the fullerene is charged. The claim is not directed to a use, but rather to a fullerene having this property.

Claim 6 is directed to the embodiment in which the neutrons are characterized in that they are capable of creating a uniform beam of free thermal neutrons at a uniform energy. The claim is not directed to a use but rather to a trapped neutron that is suitable for forming a beam at uniform energy.

Claim 7 is directed to the embodiment wherein the free thermal neutrons have the property that they are useful as an irradiation target for bombardment by other particles. The claim is not directed to a use of the fullerene, but rather to a fullerene which has the property that it is capable of being used as an irradiation target for bombardment of other particles.

Claim 8 is directed to the embodiment in which the neutrons are capable of being released as a uniform beam. Claim 8 is not directed to a use of the fullerene, but rather to an embodiment in which the neutrons in the fullerene have the property that they are capable of being released from the fullerene molecule as a uniform beam of free thermal neutrons at a uniform energy.

Claim 10 is directed to an embodiment in which the neutrons have the property that they are capable of being released from the fullerene by impinging a beam of neutron-containing fullerenes on a metal foil. Claim 10 is not directed to a use of the fullerenes, but rather to a fullerene having the property that the neutrons are capable of being released from the fullerene upon impingement of a metal foil. Thus, the fullerene is characterized that when impinged on a metal foil, the neutron is released.

Claim 11 is directed to the embodiment in which the fullerene possesses the ability to release the trapped neutron at a remote location. Claim 11 is not directed to the use of the

fullerene, but rather to a fullerene which is characterized in that the trapped thermal neutron is capable of being retained at one location and being released at a remote location. Thus, the fullerene has properties making this possible.

Claim 12 is directed to the embodiment in which the neutrons have the property that they are capable of decaying into protons. Claim 12 is not directed to a use of the fullerene, but rather to a fullerene which is characterized in that the neutrons have the property that they are capable of decaying into protons.

Claim 13 is directed to the embodiment in which the neutrons have the property that upon decay to neutrons they emit beta radiation and anti-neutrinos. Claim 13 is not directed to a use of the fullerenes, but rather to a fullerene which is characterized in that the neutrons it contains have the property that upon decay they emit beta radiation and anti-neutrinos.

Claim 14 is directed to the embodiment in which the neutrons have the property that they are capable of transforming into anti-neutrons. Claim 14 is not directed to a use of the fullerenes, but rather to fullerenes which are characterized in that the neutrons they contain are able to transform into anti-neutrons via neutron/anti-neutron oscillation. This is not a mere use but rather a property.

Claim 16 is directed to the embodiment in which the anti-neutrons have the property that they are capable of decaying into anti-protons. Claim 16 is not directed to a use of the neutrons, but rather to a fullerene which is characterized in that the neutrons have the property that they are capable of transforming to anti-neutrons and the anti-neutrons decay into anti-protons. This is not a use but a property of the material claimed.

Claim 17 is directed to the embodiment in which the anti-neutrons have the property that upon decay they emit positrons and neutrinos. Claim 17 is not directed to a use of the fullerene, but rather to fullerenes having the property that the neutrons decay into anti-neutrons and the anti-neutrons further have the property that they decay and emit positrons and neutrinos. Claim 17 recites a property and not a mere intended use. The claim is proper under §112.

Claim 18 is directed to the embodiment in which the neutrons have the property that they are capable of combining with protons to form deuterium, tritium, or mixtures thereof. Claim 18 is not directed to a use, but rather to a fullerene in which the neutrons are characterized in that they are capable of combining with protons to form deuterium, tritium or mixtures. The claim distinguishes neutrons capable of forming these materials from neutrons which do not.

Claim 19 is specifically directed to an embodiment in which the neutrons have the property that they are capable of being released from the fullerene molecule at a removed location by disassembling the fullerene using a laser or another one of the claimed forces. Thus, it is clear from the plain language of the claims that the claims are not directed to an indefinite use but would be readily understood by one skilled in the art to be directed to a fullerene in which the trapped neutron is further defined by a capability, for example, to enter into defined nuclear action or result. The claim is not directed to a mere use but rather a functional property of the fullerene proper under §112.

The Commissioner is authorized to charge any additional fee required by this paper (including the fee for any additional extension of time) or to credit any overpayment to Deposit Account No. 20-0809.

Respectfully submitted,

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Claims Appendix

1. A fullerene molecule having one or more free thermal neutrons trapped within the cage-like structure of said fullerene molecule.

2. The fullerene molecule of claim 1 wherein said fullerene molecule contains greater than about 30 carbon atoms.

3. The fullerene molecule of claim 2 wherein said fullerene molecule contains about 60 to 70 carbon atoms.

4. The fullerene molecule of claim 1 wherein said neutrons are accelerated to elevated energy levels.

5. The fullerene molecule of claim 4 wherein said neutron-containing fullerene is provided with an electrical charge.

6. The fullerene molecule of claim 4 wherein said neutrons are capable of creating a uniform beam of free thermal neutrons at a uniform energy.

7. The fullerene molecule of claim 1 wherein said free thermal neutrons are useful as an irradiation target for bombardment by other particles.

8. The fullerene molecule of claim 1 wherein said neutrons are capable of being released from said fullerene molecule as a uniform beam of free thermal neutrons at a uniform energy.

9. (Canceled)

10. The fullerene molecule of claim 8 wherein said neutrons are capable of being released from said fullerene molecule by impinging a beam of neutron-containing fullerenes on a metal foil.

11. The fullerene molecule of claim 8 wherein said neutrons are capable of being released from said fullerene molecule at a location removed from a source of said neutrons.

12. The fullerene molecule of claim 1 wherein said neutrons are capable of decaying into protons.

13. The fullerene molecule of claim 12 wherein said neutrons upon decay emit beta radiation and anti-neutrinos.

14. The fullerene molecule of claim 1 wherein said neutrons are capable of transforming into anti-neutrons via neutron/anti-neutron oscillation.

15. (Canceled)

16. The fullerene molecule of claim 14 wherein said anti-neutrons are capable of decaying into anti-protons.

17. The fullerene molecule of claim 16 wherein said anti-neutrons upon decay emit positrons and neutrinos.

18. The fullerene molecule of claim 1 wherein said neutrons are capable of combining with protons to form deuterium, tritium or a mixture thereof.

19. A C_{70} fullerene molecule having one or more free thermal neutrons trapped within said fullerene molecule, wherein said neutrons are capable of being released from said fullerene molecule at a location removed from a source of said neutrons by disassembling the fullerene molecule using a laser, an electric field, magnetic field, non-coherent electromagnetic radiation, particle bombardment, pressurization, mechanical force, heat, chemical reaction, electric current, or any combination thereof; or by impinging a beam of neutron-containing fullerene molecules on a metal foil.

20. (Canceled)

21. (Canceled)

22. (Canceled)

23. (Canceled)

24. (Canceled)

25. (Canceled)

26. (Canceled)

27. (Canceled)

28. (Canceled)

29. The fullerene molecule of claim 1 wherein the molecule is characterized in that it is a beta particle emitter, the beta particle emitter having a half life of about 10 minutes.

30. (Withdrawn)

31. (Withdrawn)

32. (Withdrawn)

33. The fullerene molecule of claim 3 wherein said fullerene contains about 70 carbon atoms.

34. The fullerene molecule of claim 1 wherein said one or more thermal neutrons are trapped within said fullerene molecule by a method which comprises irradiating said fullerene molecule in a nuclear reactor under a thermal neutron flux at a steady-state thermal power of about 10 to 500 kilowatts for about 5 to 15 minutes.

Appeals Appendix

594826-001

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today
(1) was not written for publication in a law journal and
(2) is not binding precedent of the Board.

Paper No. 27

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte DANIEL R. SCHAEFER and JAMES M. SNEAD

Appeal No. 1999-1059
Application 08/376,846

ON BRIEF

Before ABRAMS, BARRETT, and CRAWFORD, Administrative Patent Judges.

CRAWFORD, Administrative Patent Judge.

11/28/01 Request Recon/notice appeal
R 10/22

Decision on Appeal

This is a decision on appeal from the examiner's final rejection of claims 1 through 3 and 32[1]. Claims 4 through 29 have been canceled and claims 30 and 31 were not entered.

The appellants' invention relates to a fullerene molecule having one or more free thermal neutrons trapped within the cage-like structure of the fullerene molecule. An understanding of the invention can be derived from a reading of exemplary claim 1 which appears in the appendix to the appellants' brief.

The prior art

The prior art references of record relied upon by the examiner in rejecting the appealed claims are:

Smalley	5,300,203	Apr. 05, 1994
Coppa	5,350,569	Sep. 27, 1994
Watson et al.(Watson) (WO)	93/15768	Aug. 19, 1993

Jimenez-Vazquez et al. (Jimenez-Vazquez) Hot-atom incorporation of tritium atoms into fullerenes, Chemical Physics Letters, Vol. 229, pp. 111-114 (1994)

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[1] Claim 32 was added in an amendment after final filed on March 6, 1998. This final rejection does not mention claim 32. However, as claim 32 is discussed in the examiner's answer and treated as rejected by appellants in the brief (brief at page 2), we will treat claim 32 as properly rejected.

Lindstrom et al. (Lindstrom) Measuring Hydrogen by Cold-Neutron Prompt-Gamma Activation Analysis, Journal of Radioanalytical and Nuclear Chemistry Articles, Vol. 180, No. 2, pp. 271-275 (1994)

Kikuchi et al. (Kikuchi), Encapsulation of Radioactive 159 Gd and 161 Tb Atoms in Fullerene Cages, J. Of the Am. Chem. Soc. Vol. 116, pp. 9775-9776 (1994)

Neumann et al. (Neumann), Coherent Quasielastic neutron Scattering Study of the Rotational Dynamics of C60 in the Orientationally Disordered Phase, Physical Review Letters, Vol. 67, No. 27, pp. 3808-3811 (1991)

The rejections

Claims 1 through 3 and 32 stand rejected under 35 U.S.C. § 112, first paragraph.

Claims 1 through 3 and 32 stand rejected under 35 U.S.C. § 102(a) as being clearly anticipated by any of Jimenez-Vazquez, Lindstrom or Kikuchi.

Claims 1 through 3 and 32 stand rejected under 35 U.S.C. § 102(b) as being clearly anticipated by any one of Neumann, Watson, Smalley or Coppa.

Rather than reiterate the conflicting viewpoints advanced by the examiner and the appellants regarding the above-noted rejections, we make reference to the answer (Paper No. 25) for the examiner's complete reasoning in support of the rejections, and to the appellants' brief (Paper No. 24) for the appellants' arguments thereagainst.

Opinion

In reaching our decision in this appeal, we have given careful consideration to the appellants' specification and claims, to the applied prior art references, and to the respective positions articulated by the appellants and the examiner. As a consequence of our review, we make the determinations which follow.

We turn first to the examiner's rejection of claims 1 through 3 and 32 under 35 U.S.C. § 112, first paragraph. We initially note that the description requirement found in 35 U.S.C. § 112 is separate from the enablement requirement of that paragraph. See In re Wilder, 736 F.2d 1516, 1520, 222 USPQ 369, 372 (CCPA 1977). As the examiner states that the disclosure is too vague and incomplete to enable one skilled in the art to make a proper and accurate analysis of exactly what was done, it is our determination that the examiner's rejection is based on the enablement clause of 112.

An analysis of whether the claims under appeal are supported by an enabling disclosure requires a determination of whether that disclosure contained sufficient information regarding the subject matter of the appealed claims as to enable one skilled in the pertinent art to make and use the claimed invention. The test for enablement is whether one skilled in the art could make

and use the claimed invention from the disclosure coupled with information known in the art without undue experimentation. See United States v. Telectronics, Inc., 857 F.2d 778, 785, 8 USPQ2d 1217, 1223 (Fed. Cir. 1988), cert. denied, 109 S.Ct. 1954 (1989); In re Stephens, 529 F.2d 1343, 1345, 188 USPQ 659, 661 (CCPA 1976).

In order to make a rejection, the examiner has the initial burden to establish a reasonable basis to question the enablement provided for the claimed invention. See In re Wright, 999 F.2d 1557, 1561-62, 27 USPQ2d 1510, 1513 (Fed. Cir. 1993) (examiner must provide a reasonable explanation as to why the scope of protection provided by a claim is not adequately enabled by the disclosure).

Once the examiner has established a reasonable basis to question the enablement provided for the claimed invention, the burden falls on the appellants to present persuasive arguments, supported by suitable proofs where necessary, that one skilled in the art would be able to make and use the claimed invention using the disclosure as a guide. See In re Brandstadter, 484 F.2d 1395, 1406, 179 USPQ 286, 294 (CCPA 1973). In making the determination of enablement, the examiner shall consider the original disclosure and all evidence in the record, weighing

evidence that supports enablement[2] against evidence that the specification is not enabling.

Thus, the dispositive issue is whether the appellants' disclosure, considering the level of ordinary skill in the art as of the date of the appellants' application, would have enabled a person of such skill to make and use the appellants' invention without undue experimentation. The threshold step in resolving this issue as set forth supra is to determine whether the examiner has met his burden of proof by advancing acceptable reasoning inconsistent with enablement. We adapt this reasoning and provide the following additional comments.

In the instant case, examiner is of the opinion that there is no enabling disclosure of how and in what manner it is determined and ensured that thermal neutrons are actually caused to be trapped in the fullerene and remain trapped in the fullerene.

We note that appellants' disclosure indicates that prior to the instant invention there was no known procedures for encapsulating neutrons within a fullerene molecule (specification

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[2] The appellants may attempt to overcome the examiner's doubt about enablement by pointing to details in the disclosure but may not add new matter. The appellants may also submit factual affidavits under 37 CFR § 1.132 or cite references to show what one skilled in the art knew at the time of filing the application.

at page 2). Yet, the only procedure disclosed in appellants' specification for capturing thermal neutrons within a fullerene molecule is to expose a fullerene molecule to a neutron flux of 10 to 500 kilowatts for about 5 to 15 minutes (specification at pages 5 and 7).

The specification states that the evidence that neutrons are trapped in the fullerene molecule consists of the presence of pure beta emitters with a half life of ten minutes in the fullerene that remain after the counts resulting from the gamma emitters have been stripped from the raw data.

The appellants' specification also states that there are few pure beta emitters and that fewer have a half life of ten minutes. However, the appellants have not submitted evidence to establish that the beta emitters in the fullerene molecule are not in fact other pure beta emitters. In this regard just because there are few pure beta emitters other than thermal neutrons does not establish that these other pure beta emitters are not within the fullerene.

In addition, it is our view that a person of ordinary skill in the art would not be enabled by the appellants' disclosure to ensure that even if thermal neutrons are the pure beta emitters, these thermal neutrons are in fact within the fullerene molecule rather than in the sample outside the fullerene or bonded to the

fullerene itself. In this regard, we note that Jimenez-Vazquez at page 112 indicates that although some tests may indicate that a substance is bonded to a fullerene, these test do not necessarily prove that the substance is within the fullerene.

In view of the foregoing, it is our conclusion that the examiner has established a prima facie case of lack of enablement and that the burden has shifted to the appellants to establish that the claimed subject matter is in fact enabled by the appellants' disclosure.

The appellants have presented several arguments in the brief which seek to establish that thermal neutrons are encapsulated within the fullerene. However, argument of counsel is no substitute for evidence. The only evidence submitted by the appellants is a declaration of Joseph W. Talnagi. The examiner has not considered this declaration. The declaration states:

> I consider the procedure effective to confirm the presence of free thermal neutrons in a fullerene molecule. I believe that the procedure described in the patent application at pages 7-9 could be easily repeated by a person skilled in the art of neutron activation analysis to detect thermal neutrons trapped in a fullerene molecule.

The above statements are conclusory in nature and the declaration does not include facts upon which the conclusions were based and therefore, even if we were to consider this declaration, it does not rebut the examiner's prima facie case of lack of enablement.

As such, we will affirm the examiner's rejection of claims 1 through 3 and 32 under 35 U.S.C. § 112, first paragraph.

We turn next to the examiner's rejection under 35 U.S.C. § 102 as being anticipated by any of Jimenez-Vazquez, Kikuchi or Lindstrom. To support a rejection of a claim under 35 U.S.C. § 102(b), it must be shown that each element of the claim is found, either expressly described or under principles of inherency, in a single prior art reference. See Kalman v. Kimberly-Clark Corp., 713 F.2d 760, 772, 218 USPQ 781, 789 (Fed. Cir. 1983), cert. denied, 465 U.S. 1026 (1984).

In the instant case, the examiner is of the opinion that each of Jimenez-Vazquez, Lindstrom and Kikuchi disclose the thermal neutron irradiation of fullerene molecules. The examiner refers to pages 111 and 112 of Jimenez-Vazquez, pages 271-273 of Lindstrom and page 9775 of Kikuchi. The examiner reasons that as the references each refer to irradiation of fullerene molecules with thermal neutrons, each reference must also inherently result in the production of a fullerene molecule having one or more free thermal neutrons trapped inside because the reference illustrates a method identical to appellants method of manufacturing the claimed product.

Jimenez-Vazquez discloses a method in which a sample containing Li and fullerenes is exposed to neutron irradiation.

The fullerene utilized in appellants' method does not contain lithium. In addition, the conditions that are disclosed for the appellants' method are not disclosed in Jimenez-Vazquez. For instance Jimenez-Vazquez discloses that the fullerene is exposed for 30 seconds and the appellants fullerene are exposed for 5 to 15 minutes. In addition, Jimenez-Vazquez does not disclose a neutron flux at a steady state thermal power of 10 to 500 kilowatts. As such, the Jimenez-Vazquez method is not identical to appellants' method. Therefore, in our view, the examiner has no factual basis for finding that thermal neutrons are inherently contained within the fullerene.

Kikuchi discloses a method in which a $Gd@C_{82}$ was irradiated by neutrons for the activation of Gd isotopes. The sample was irradiated for 6 hours rather than 10 to 15 minutes. The sample was not irradiated at a neutron flux of 10 to 500 kilowatts. As with Jimenez-Vazquez, Kikuchi does not disclose the identical method of the appellants and such the examiner's factual finding of inherency cannot be stand.

Lindstrom discloses a method to measure the hydrogen concentration in samples such as a fullerene molecule. However, we agree with the appellants that since Lindstrom does not disclose any details of the procedure such as the neutron flux or the duration of the irradiation, Lindstrom does not disclose a

method identical to the method utilized my the appellants. As the examiner has failed to establish that the method in Lindstrom is identical to appellants' method, the examiner has failed to establish a prima facie case of anticipation by Lindstrom.

Accordingly, we will not sustain the examiner's rejection of claims 1 through 3 and 32 as being anticipated by Jimenez-Vazquez, Kikuchi or Lindstrom.

We turn next to the examiner's rejection of claims 1 through 3 and 32 under 35 U.S.C. § 102(b) as being anticipated by any of Neumann, Watson, Smalley or Coppa. In support of this rejection, the examiner states:

> [T]he references are each considered as at least inherently referring to the thermal neutron irradiation of fullerene molecules. This is also how appellant makes the claimed article of a fullerene molecule with a thermal neutron trapped therein.[Examiner's answer page 8.]

In regard to Neumann the examiner states:

> Neumann et al (II) refer to neutron irradiation of fullerenes with neutrons from the NBSR (reactor) at NIST (e.g. see page 3808). Such would inherently involve thermal neutrons and in any event, any non-thermal neutrons would become thermalized due to the carbon and graphite which is present. [Examiner's answer at page 7]

We agree with the appellants that the disclosure in Neumann does not disclose enough details about the method therein described to establish that a thermal neutron is necessarily

captured in a fullerene. For instance, Neumann does not disclose the power of the irradiation or the length of the irradiation. In view of the lack of details disclosed in Neumann, it is our opinion that the examiner has no factual basis for concluding that neutrons are captured in the fullerene molecule.

In regard to the Watson reference, the examiner states:

> Watson et al (e.g. see pages 7,8,25,38,43) refer to the use of fullerenes for neutron capture therapy for cancer patients (such inherently involves the use of thermal neutrons). [Examiner's answer at page 7.]

We agree with the appellants that Watson discloses enclosing a metal atom or ion within the fullerene cage rather than enclosing a neutron within a fullerene cage (page 7 to 8). Watson does not disclose that a fullerene is irradiated with a neutron flux of 10 to 500 watts for 10 to 15 minutes. As such, we do not agree that the examiner has established that a thermal neutron is necessarily enclosed in a fullerene molecule in Watson.

In regard to Smalley and Cappa, the examiner states:

> Due to the carbon and other materials present, at least a portion of these neutrons will be thermalized. These neutrons will thus be available to interact with the fullerenes which are present, just as in appellants case. [Examiner's answer at pages 7 to 8.]

The examiner has not met his burden for establishing a prima facie case of anticipation by inherency in regard to Smalley and Cappa because the examiner has not established that the conditions disclosed in Smalley and Cappa would necessarily result in a thermal neutron being captured in the fullerene cage. We note that neither Smalley nor Cappa disclose a neutron flux of 10 to 500 watts and a neutron flux of 10 to 15 minutes. It is not enough that the examiner establish that the neutrons that are in the examiner's opinion produced in Smalley and Cappa are available to interact with the fullerene molecules. The examiner must establish that they are necessarily captured in the fullerenes disclosed in Smalley and Cappa. This the examiner has not done.

In view of the foregoing, we will not sustain the examiner's rejection of claims 1 through 3 and 32 as being anticipated by Neumann, Watson or Smalley or Cappa.

In summary:

The examiner's rejection of claims 1 through 3 and 32 under 35 U.S.C. § 112, first paragraph is sustained.

The examiner's rejection of claims 1 through 3 and 32 under 35 U.S.C. § 102(a) as being anticipated by any of Jimenez-Vazquez, Kikuchi or Lindstrom is not sustained.

The examiner's rejection of claims 1 through 3 and 32 under 35 U.S.C. § 102(b) as being anticipated by Neumann, Smalley or Coppa is not sustained.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136 (a).

AFFIRMED

Neal E. Abrams)
Administrative Patent Judge)
)
)
Lee E. Barrett)
Administrative Patent Judge) BOARD OF PATENT
) APPEALS AND
)
Murriel E. Crawford) INTERFERENCES
Administrative Patent Judge)

MC/dym

Appeal No. 1999-1059
Application No. 08/376,846

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Evidence Appendix

Attached is the Second Declaration of Joseph W. Talnagi under 37 CFR §1.132 which was submitted in response to the Office Action dated March 21, 2002.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Applicants	:	Daniel Richard Schaefer, et al.
Serial No.	:	09/996,244
Filed	:	November 28, 2001
Title	:	TRAPPING AND STORAGE OF FREE THERMAL NEUTRONS IN FULLERENE MOLECULES
Docket	:	594826-001C1
Art Unit	:	3641

SECOND DECLARATION OF JOSEPH W. TALNAGI under 37 C.F.R. §1.132

I, Joseph W. Talnagi, declare and state the following:

I am the same Joseph W. Talnagi who executed the Declaration under 37 C.F.R. §1.132 of Record in U.S. Application Serial No. 08/376,846 filed January 23, 1995 entitled Trapping and Storage of Free Thermal Neutrons in Fullerene Molecules.

I have carried out the procedures outlined at pages 7-10 of the current application wherein a fullerene sample is placed in a neutron flux within a nuclear reactor and irradiated at a steady-state thermal power between 10 and 500 kilowatts for a period of about 5 to 15 minutes, and I have obtained fullerene samples exhibiting a beta emission with a half life of about 10 minutes ± one minute.

I understand that the Board of Patent Appeals and Interferences has taken the position that the results reported in the application do not establish that the beta emission is, in fact, caused by thermal neutrons trapped within the central cavity of a fullerene molecule and that the beta emission may be attributed to other sources. I understand that the Board affirmed a rejection of the application under the first paragraph of 35 U.S.C. §112 stating that:

> "However, the appellants have not submitted evidence to establish that the beta emitters in the fullerene molecule are not in fact other pure beta emitters."

In order to verify that that the beta emission that I observed is not the beta emission of another beta emitter, using the 75th edition of the CRC Handbook of Physics and Chemistry I identified those beta emitters having a half-life in the range of 6.0 to 15.0 minutes as follows:

143 La, 179 Yb, 191 Re, 195 Os, 212m Bi, 213 Pb, 215 Bi, 222 Fr, 226 Rn, 256 Cf, 78 Br, and 49 Ca

If any of these isotopes was responsible for the beta emission I observed, the isotope itself or a sister isotope would be detectable in the fullerene molecule. However, the fullerene used for the experiment was carefully analyzed and none of these isotopes or their sister isotopes was present. Further, of the listed radioactive forms, only 49Ca is produced by direct capture of a thermal neutron, and I saw no evidence of its presence in the samples in the form of its characteristic gamma emissions. Accordingly, the only beta emitter that I have been able to identify that would produce the beta emission I observed for the fullerene is a thermal neutron.

I am also familiar with the Board's statement that the application is defective because:

> "A person of ordinary skill in the art would not be enabled by the appellants' disclosure to ensure that even if thermal neutrons are the pure beta emitters, these thermal neutrons are in fact within the fullerene molecule rather in the sample outside the fullerene or bonded to the fullerene itself."

The issue that the Board raises is not viable because a thermal neutron would be incapable of producing a beta emission having a half life of approximately 10 minutes unless it is present in the sample as a free thermal neutron. A neutron removed from the confines of an atomic nucleus is unstable. Given the small sample size, the velocity of a thermal neutron, and its mean free path in the materials composing the test samples, a neutron will either escape from the confines of the sample and thereby be lost to detection, or it will interact with the nuclei of the atoms forming the sample. This interaction can result in elastic scattering, inelastic scattering, or absorption. Scattered neutrons will either leak from the sample and be lost, or continue to scatter until they are absorbed. It is unlikely that a free thermal neutron

would externally attach itself to an atom or molecule in a manner analogous to a chemical bond. Once a thermal neutron is captured within an atomic nucleus, the neutron is no longer a "free" neutron and it is no longer able to produce a beta decay having the characteristic half life of a free neutron. That fullerene molecules produce a beta decay having the half life of free neutrons is a unique feature of the invention described in the application.

In an experiment of the nature I performed, given the materials used, the most likely location that a thermal neutron could reside and exhibit the characteristic half life of a free neutron is within the central cavity of a fullerene molecule. In all other likely interactions, the thermal neutron would either be absorbed by the atomic nuclei which this would render the thermal neutron incapable of decaying with the characteristic half life, or escape from the sample and thus not be detectable by its beta decay.

Based upon the foregoing analysis, a person skilled in this art would conclude that the applicants have captured a thermal neutron in the central cavity of the fullerene molecule.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed by: Joseph W. Talnagi On: June 17, 2002

Joseph W. Talnagi
Senior Research Associate
The Ohio State Research
Reactor Laboratory